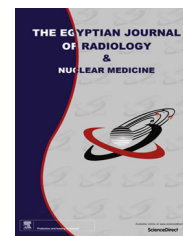




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ORIGINAL ARTICLE

# Role of T2wi as a primary method in detection of late post radical cystectomy complications



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## KEYWORDS

Radical cystectomy;  
T2wi;  
MRI;  
HR-T2wi

**Abstract** *Purpose:* To evaluate the role of T2wi as a primary method in detection of late post radical cystectomy complications.

*Patients & methods:* 236 patients underwent radical cystectomy and urine diversion. Postoperatively, every 6 months MRI was done: T2wi of the abdomen and HR-T2wi of the pelvis at 1.5T searching for postoperative complications.

*Results:* 12/236 cases (5%) with post-operative complications in the form of fluid collection, 40/236 cases (16.9%) with local recurrence; 3 cases were diagnosed by histology as inflammatory condition, 19/236 cases (8%) with lymph node enlargement, 39/236 cases (16.5%) with hydronephrosis, 10/236 cases (4.2%) with unilateral and 29/236 cases (12.3%) with bilateral, 37/236 cases (15.7%) with pyelonephritis, 9/236 cases (3.8%) with bone metastasis, 3/236 cases (1.3%) with liver metastasis, pouch stone in 5/236 cases (2%), 4/236 cases (1.7%) with pelvi-calyceal masses and 83/236 cases (35.2%) with no abnormality detected. The accuracy of the MRI in detection of the complication was 98.7%.

*Conclusion:* Axial T2wi of the abdomen and pelvis is an accurate primary method for evaluation of radical cystectomy as it is a simple technique with no intravenous contrast media or radiation exposure.

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## 1. Introduction

Urinary bladder cancer is the second most common malignancy of all genitourinary tumors and is nearly three times

more common in men than in women (1). Radical cystectomy with pelvic lymph node dissection provides the best surgical treatment for muscle invasive urothelial tumor (2,3) and is the standard treatment, with 10-yr recurrence-free survival rates of 50–59% and overall survival rates of around 45% (2,4).

Numerous surgical procedures have been developed for cystectomy and urine diversion and multiple post-operative complications developed after the operation (5).

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The multiplanar and soft tissue characterization capabilities of Magnetic Resonance Imaging (MRI) and void of ionizing radiation make it the modality of choice in imaging the abdomen and pelvis as well as it is a fast non invasive technique (6).

To our knowledge few authors discussed the role of imaging especially MRI in detection of late complications of radical cystectomy. So, the purpose of this study was to evaluate the advantages and values of T2wi MRI study of the abdomen and pelvis in detection of late complications in post-radical cystectomy patients and their serial follow-up.

## 2. Patients and methods

This retrospective study was done between January 2012 and August 2015 including 236 patients with their age rang between 40 and 75 years, with histology proven UBC, who underwent radical cystectomy and urine diversion. Postoperatively, every 6 months they were examined by MR imaging (1.5T): T2wi of the abdomen and high resolution T2wi (HR-T2wi) of the pelvis. Patients complaining between scheduled visits of any symptoms were immediately evaluated.

Searching for late postoperative complications, pelvic local recurrence, kidney changes or other conditions may develop. In pelvic fluid collection, pelvic recurrence and lymph node recurrence the standard was biopsy. In cases with upper urinary tract malignancy and ureter, post-operative histopathology was the gold standard.

### 2.1. MRI protocol

All examinations were performed using a 1.5 T MR Unit (SIGNA Horizon, General Electric Medical System, Milwaukee, WI). Axial T2wi of the abdomen (fast spin-echo (FSE), using Torso coil, TR/TE: 3000/90, FOV: 28 cm, Matrix size: 256 × 219, NEX: 2, Slice Thickness: 10 mm and Intersection gab: 2). High Resolution HR-T2wi of the pelvis (fast spin-echo (FSE), using Torso coil, TR/TE: 4240/90, FOV: 18 cm, Matrix size: 265 × 224, NEX: 4, Slice Thickness: 3 mm and Intersection gab: 1).

### 2.2. MR image analysis

All the sequences done were reviewed for each patient. The T2wi of the abdomen was reviewed for liver size, texture and presence of focal metastatic lesions. Also these images were reviewed for retroperitoneal lymphadenopathy as well as the condition of both kidneys as regards the presence of unilateral or bilateral hydronephrosis or development of upper urothelial mass.

High Resolution (HR) T2wi of the pelvis was reviewed for fluid collections, presence of lymphadenopathy or any abnormal soft tissue masses which is denoting evidence of local recurrence.

## 3. Results

Our retrospective study included 236 patients: 156 males (66.1%) and 80 females (33.9%); their age ranges from 40 to 75 years. All patients with histology proven UBC underwent radical cystectomy and urine diversion. Postoperatively, every

6 months or if patients were complaining between scheduled visits of any symptoms, they were immediately evaluated. They were examined by MR imaging (1.5T) Unit (SIGNA Horizon, General Electric Medical System, Milwaukee, WI) using surface coil. The MRI study in the form of axial T2wi of the abdomen and axial high resolution T2wi (HR-T2wi) of the pelvis searched for the late post-operative complications (Fig. 1).

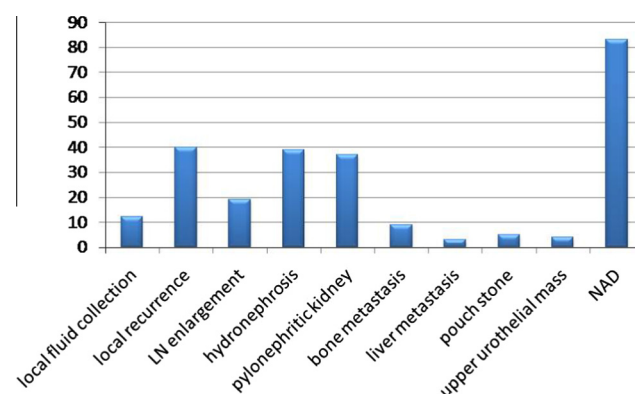
As regards the MRI study 12/236 cases (5%) were diagnosed as local fluid collection in the form of well defined structure, and its contents are hyperintense at T2wi with thin hypointense wall (Fig. 2). All the 12 patients underwent CT or US guided aspiration (8 patients underwent CT guided aspiration and 4 patients underwent US guided aspiration) with chemical analysis of the fluid. All the collections were serum fluid. So the accuracy of the T2wi in detection was 100%.

Forty cases from 236 cases (16.9%) were diagnosed by MRI as pelvic local recurrence in the form of soft tissue mass (Figs. 3 and 4), after CT guided biopsy and histopathological examinations; 37 cases (92.5%) were diagnosed as malignant lesion and 3 cases (7.5%) were diagnosed by histopathology as inflammatory condition (Fig. 5). So, the accuracy of T2wi was 92.5%.

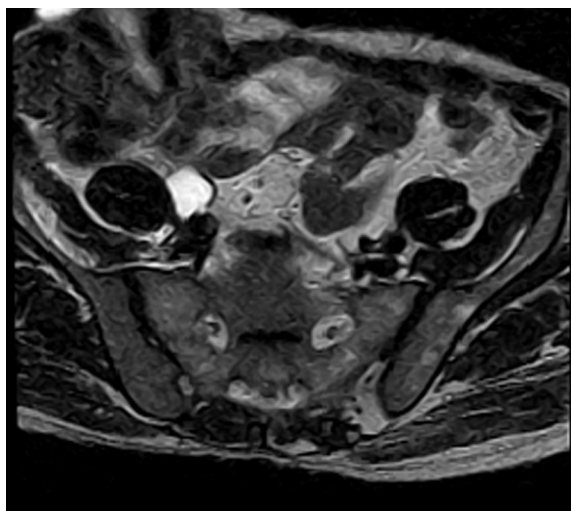
Four cases from 236 cases (1.7%) were diagnosed by T2wi as pelvi-calyceal masses appear as lesions of soft tissue intensity inside the PCS or ureter. All these cases were confirmed with histopathological examinations after radical nephrectomy or ureteroscopic biopsy.

Nineteen cases from 236 cases (8%) showed lymph node enlargement diagnosed by T2wi as a well defined soft tissue mass (Fig. 6) of intermediate SI in the anatomical site of the lymph node, after CT guided biopsy and histopathological examinations all patients were diagnosed as malignant lesion, so the accuracy of MRI was 100%.

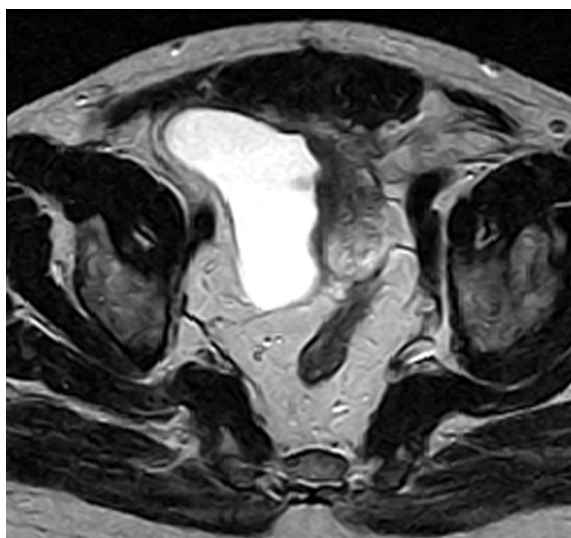
In thirty-nine cases from 236 cases (16.5%) with hydronephrosis, 10/236 cases (4.2%) with unilateral hydronephrosis (Fig. 7) and 29/236 cases (12.3%) with bilateral hydronephrosis (Fig. 8), their picture appears in the T2wi as dilated PCS with different degrees. To confirm our diagnosis, we compared the T2wi results with the results of the antergrade pyelography after PCN fixation in obstructed cases diagnosed by renogram, while in cases of urine reflux, the comparison was with retrograde pyelography. 37/236 cases (15.7%) with pyelonephritic changes (Fig. 9) in the form of dilated scattered calyces were not connected to each other.



**Fig. 1** Chart revealing the different complications found among the 236 patients included in the study.



**Fig. 2** Axial high resolution (HR) T2wi of the pelvis revealing a small well defined thin walled fluid collection with hyperintense contents at the anatomical site of LN diagnosed as lymphocele.



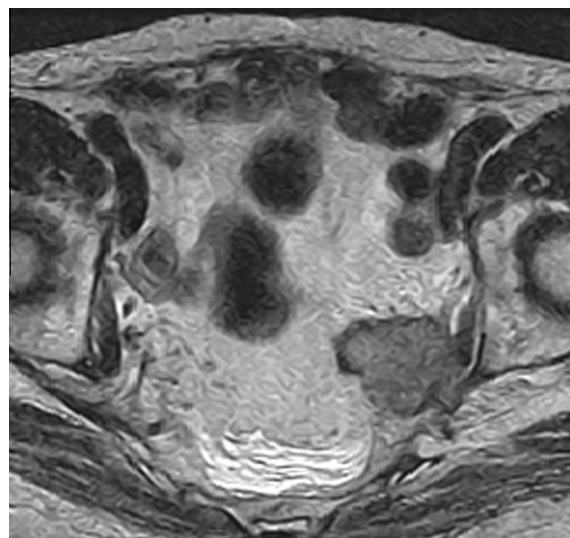
**Fig. 3** Axial HR T2wi of the pelvis showing a well defined soft tissue mass related to the left side of the pouch of intermediate SI confirmed by CT guided biopsy as local recurrence.

So, the accuracy of T2wi in detection of upper UT changes was 100%.

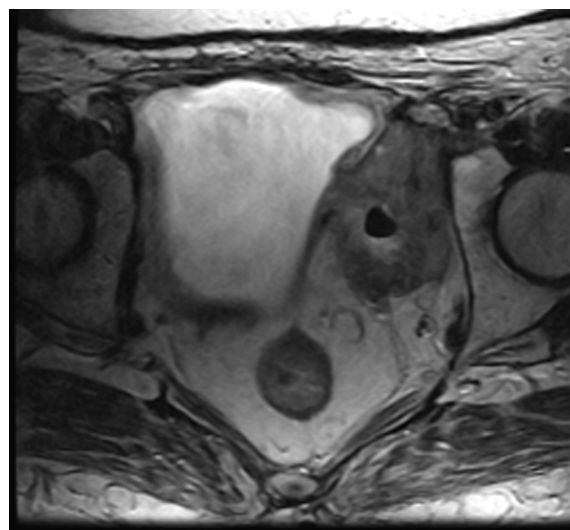
Pouch stones were found in 5/236 (2%) cases appearing as signal void structures (Fig. 10) inside the pouch in T2wi examination. All the patients underwent operative extractions of the stone.

Nine cases from 236 cases (3.8%) were suspected for bone metastasis (Fig. 11) and they were investigated also by STIR MRI sequence and bone scan for confirmation of presence of metastasis with 100% accuracy of T2wi in detection.

Three cases from 236 cases (1.3%) were diagnosed as hepatic metastasis; all the three cases were confirmed by US examination and heavy T2wi MRI of the liver as well as liver biopsy with histopathological examination. So the accuracy of T2wi in detection of hepatic focal lesion was 100%.



**Fig. 4** Axial high resolution (HR) T2wi of the pelvis revealed soft tissue mass of intermediated SI at the left side of the pelvic region posteriorly in the anatomical site of LN confirmed by CT guided biopsy as local recurrence.



**Fig. 5** Axial high resolution (HR) T2wi of the pelvis revealed soft tissue mass of intermediate SI at the left side of the pouch with signal void structure inside denoting air locule confirmed by CT guided biopsy as inflammatory lesion.

Eighty-three cases from 236 cases (35.2%) with no abnormality detected at all had follow-up examinations.

After the global analysis of the collected data the accuracy of the T2wi MRI study in detection of the late post radical cystectomy complication was 98.7%.

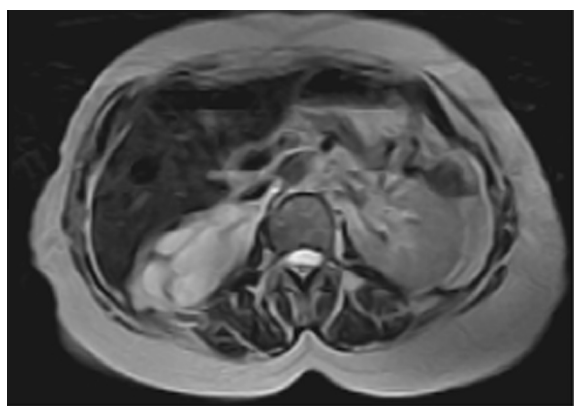
#### 4. Discussion

Early and late post radical cystectomy is frequently occurring. Possible complications include anastomotic leaks, fluid collections (abscess, urinoma, lymphocele, and hematoma), ureteral strictures, calculi, and tumor recurrence (7). To our knowledge





**Fig. 6** Axial high resolution (HR) T2wi of the pelvis revealed large soft tissue mass of intermediate SI at the right side of the pelvic region encasing the right iliac arteries confirmed by CT guided biopsy as lymph node local recurrence.



**Fig. 7** Axial T2wi of the abdomen revealing marked right hydronephrosis with thin atrophic parenchyma.

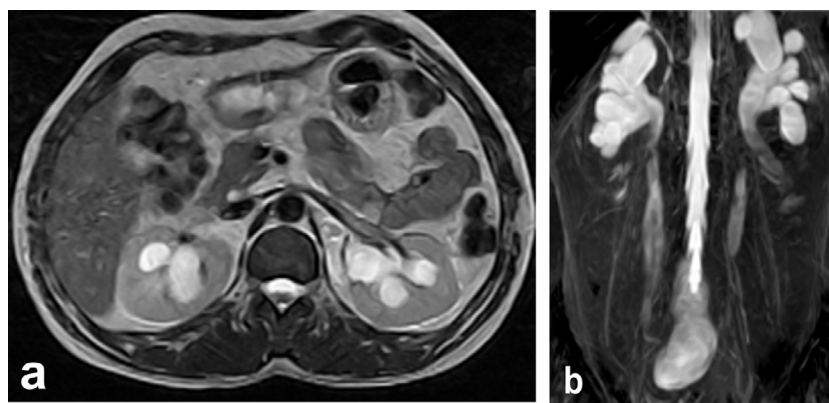
few authors discussed the role of imaging especially MRI in detection of late complications of radical cystectomy. So, our purpose in this study was to evaluate the advantages and values of T2wi MRI study of the abdomen and pelvis in detection of late complications in post-radical cystectomy patients and their serial follow-up.

All patients included in the study with histology proven UBC underwent radical cystectomy and urine diversion. Post-operatively, every 6 months or if patients were complaining between scheduled visits of any symptoms, they were immediately evaluated. They were examined by MR imaging (1.5T) Unit using surface coil. The MRI study in the form of T2wi of the abdomen and high resolution T2wi (HR-T2wi) of the pelvis searched for the post radical cystectomy complications.

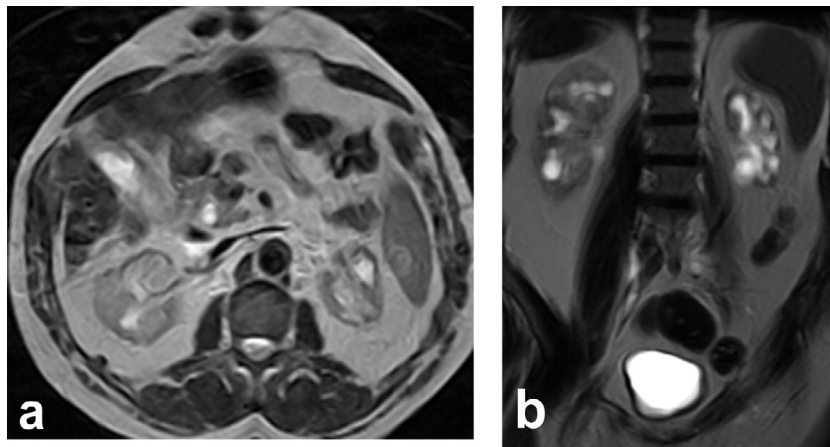
The differential diagnosis of late post radical cystectomy fluid collections includes urinoma and lymphocele. Urinoma is considered as early complication and lymphocele considered as late complication. Such collections frequently are found in the location of the excised bladder and may mimic its morphologic structure (7). After MRI data analysis and among the 236 cases, 12 cases diagnosed as localized fluid collection which appeared as a well defined structure with thin hypointense wall and hyperintense contents at T2wi. All the 12 patients underwent CT or US guided aspiration with chemical analysis of the fluid resulting. All the collections were serum fluid. So the accuracy of the T2wi in detection of fluid collection was 100%.

Patients diagnosed with asymptomatic recurrences during routine follow-up after radical cystectomy had a slightly higher survival than patients with symptomatic recurrences which is important to be detected and diagnosed (8). The rate of local recurrence after radical cystectomy has been reported to range between 5% and 16.5% within 5 yr after surgery. Most of these recurrences are diagnosed during the first 24 months (8).

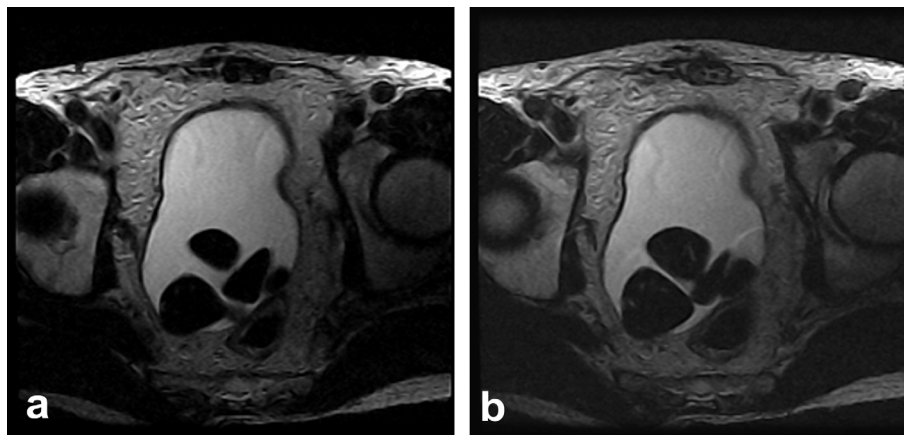
Forty cases from 236 cases (16.9%) included in our study were diagnosed by T2wi as pelvic local recurrence in the form of soft tissue mass at the site of the operation, and after CT guided biopsy and histopathological examinations 37 cases (92.5%) were diagnosed as malignant lesion and 3 cases (7.5%) were diagnosed by histopathology as inflammatory condition. So, the accuracy of T2wi was 92.5%. The percentage of the local recurrence incidence is similar to the incidence



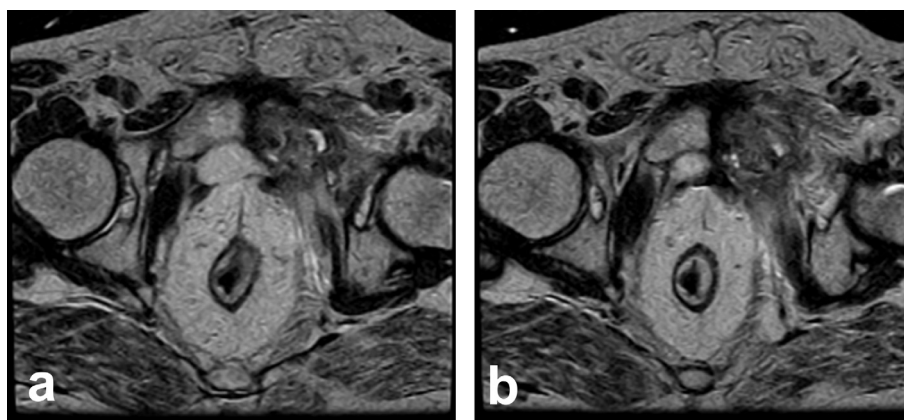
**Fig. 8** Axial T2wi of the abdomen (a); bilateral mild hydronephrosis. While (b) MIP MR urography of the same case showing bilateral mild hydroureteronephrosis down to the pouch.



**Fig. 9** Axial T2wi of the abdomen (a) revealing dilated scattered calyces of both kidneys with no hydronephrotic changes. Confirmed by (b) coronal T2wi of the abdomen and pelvis.



**Fig. 10** (a and b) Axial high resolution (HR) T2wi of the pelvis revealed multiple large signal void structures inside the pouch denoting large stones.



**Fig. 11** Axial high resolution (HR) T2wi of the pelvis revealing an ill defined mass seen at the left pubic bone with related soft tissue component diagnosed as bone metastasis.

of recurrence of Giannarini et al. (8) but they used CT in the diagnoses. Nineteen cases from 236 cases (8%) with lymph node enlargement were diagnosed by T2wi as a well defined soft tissue mass of intermediate SI in the anatomical site of

the lymph node compared with the histopathology results of the CT guided biopsy with MRI accuracy (100%).

Upper urinary tract recurrence occurs in 1.8–6% of cases after radical cystectomy and is seen later than urethral

recurrence. In fact, the upper urinary tract is the most common site of late recurrence (9). Computed tomography urography (CTU) and intravenous urography (IVU) are standard examinations for the exploration of the upper urinary tract; CT urography has replaced intravenous excretory urography in many places but carries a larger radiation exposure (10). An alternative is MRI urography. A yearly investigation of the upper tract is recommended in patients during follow-up for high-risk tumours, including CIS (11). Four cases from 236 cases (1.7%) included in our study were diagnosed by T2wi as pelvi-calyceal masses. All the cases were confirmed with histopathological examinations after radical nephrectomy or ureteroscopic biopsy. The incidence of the multiplicity of the urothelial tumor equals the results of Soukup et al. (9), but the tissue characterization capability of MRI makes it a modality of choice.

Urinary obstruction is not frequently seen in the first 30 days after surgery. An error in surgical technique at the uretero-intestinal anastomosis is the usual cause of this complication in the early postoperative period (7). If a moderate or severe obstruction is detected, surgical revision (construction of a new uretero-intestinal anastomosis) is required (1). T2wi is especially suited for imaging of the dilated urinary tract in which the large amount of water generates a good signal-to-noise ratio (12).

Thirty-nine cases from 236 cases (16.5%) in our study presented with hydronephrosis; 10/236 (4.2%) cases with unilateral hydronephrosis and 29/236 cases (12.3%) with bilateral hydronephrosis appear in the T2wi as dilated PCS with different degrees. To confirm our diagnosis; we compared the T2wi results with the results of the anterograde pyelography after PCN fixation in obstructed cases diagnosed by renogram, while in cases of urine reflux, the comparison was with retrograde pyelography. 37/236 cases (15.7%) with pyelonephritic changes in the form of dilated scattered calyces were not connected to each other, also confirmed in the routine US examination in the outpatient follow-up. So, the accuracy of T2wi in detection of upper UT changes was 100%.

Pouch stones were found in 5/236 cases (2%) appearing as signal void structures inside the pouch in T2wi examination. All cases were confirmed after the surgical extraction of the stones.

MRI is very sensitive to detect bone metastases. To improve specificity, a clever use of sequences, spin echo, gradient echo in or opposed phase, contrast medium and diffusion is needed (13). MRI is potentially the technique of choice in evaluating bone metastases as it is sensitive to early changes in bone marrow that precede the osteoblastic response in the bone matrix. Metastasis to bone marrow leads to a lengthened T1 relaxation time and signal loss, which contrasts with the surrounding high signal marrow fat. The conspicuity of bone metastases can sometimes be increased by T2-weighted fat-suppressed sequences such as short tau inversion recovery (STIR) (14). Nine cases from the 236 cases (3.8%) were suspected for bone metastasis and they were investigated also by STIR MRI sequence for confirmation of presence of metastasis with 100% accuracy of T2wi in detection.

Metastatic disease in the liver usually indicates advanced disease and a poor prognosis (15). With improvements in hardware and software, MRI has in recent years assumed an important role in the evaluation of the liver for focal diseases. The sensitivity of unenhanced MRI, however, is considered to

be equal or at best only marginally higher than that of contrast enhanced CT (16). In our study 3/236 cases (1.3%) diagnosed as hepatic metastasis, and all the three cases were confirmed by US examination as well as heavy T2wi MRI of the liver as liver metastasis and also were compared with the histopathology result after hepatic biopsy. So that accuracy of T2wi in detection of hepatic focal lesion was 100%.

Eighty-three cases from 236 (35.2%) cases with no abnormality detected at all had follow-up examinations.

After the global analysis of the collected data the accuracy of the T2wi MRI study in detection of the post-radical cystectomy complication was 98.7%.

## 5. Conclusion

Axial T2wi of the abdomen and pelvis is an accurate primary method for evaluation of radical cystectomy patients as it is a simple technique with no intravenous contrast media or radiation exposure.

## Conflict of interest

We have no conflict of interest to declare.

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